Claims:

We claim:

1. A process comprising the steps of,

a) providing a multi-stage spiral wound hardness rejecting module of membranes having a feed/concentrate side and a permeate side;

b) flowing pressurized feed water through the feed/concentrate side of the module in a single pass, the feed water having a superficial velocity of between 0.05 and 0.4 feet per second over the last portion of membranes on the feed/concentrate side of the module; and,

c) collecting at least 70% of the feed water as permeate from the permeate side of the module.

2. The process of claim 1 wherein between 80% and 95% of the feed water is collected as permeate.

3. The process of claim 1 wherein the module is a 40" length module having a permeability of less than about 0.6 gfd/psi.

4. The process of claim 1 wherein the permeate has at least 30% less hardness than the feed water.

5. The process of claim 1 wherein the minimum feed side superficial velocity is in the range of 0.05 ft/s to 0.4 ft/s.

6. The process of claim 5 wherein either the minimum superficial feed side velocity or exit superficial velocity is in the range of 0.12 ft/s to 0.3 ft/s.

7. The process of claim 1 wherein the feed water is taken from a well and contacted with air to increase its dissolved oxygen content before flowing it to the module.

8. The process of claim 1 wherein the permeate is collected in a holding tank and the step of flowing pressurized feed water begins when the pressure or water level of the permeate in the holding tank reaches a selected limit.

9. The process of claim 8 wherein the step of flowing pressurized feed water is stopped when the level or pressure of permeate in the holding tank reaches a selected limit.

10. The process of claim 1 further comprising the steps of,

a) flowing water containing cleaning chemical to the feed/concentrate side of the module;

b) holding the cleaning chemical in the feed/concentrate side module for a reaction time;

c) discharging the cleaning chemical from the feed/concentrate and permeate sides of the module.

11. The process of claim 10 wherein the steps of claim 10 are started when the permeability of the membranes reaches a selected limit or at selected time intervals.

12. The process of claim 10 wherein the cleaning chemical is provided by mixing cleaning chemical into feed water flowing into the module.

13. The process of claim 10 wherein the cleaning chemical is provided in a flow of liquid into a concentrate outlet of the module.

14. The process of claim 10 wherein the cleaning chemical flows into the feed/concentrate side of the module by gravity induced flow.

15. The process of claim 1 wherein the permeate side of the module has no inlet from outside of the module.

16. The process of claim 1 wherein the holding tank has a pressure above ambient adapted to supply permeate to a user without further pressurization.

17. The process of claim 1 wherein the membrane material rejects salt.

18. The process of claim 1 wherein the module has multiple stages on its feed side.

19. The process of claim 18 wherein the module has a membrane area exit and a first stage and the velocity of feed or concentrate over the membrane area exit is a factor of 1.2 or more times the velocity of feed or concentrate in the first stage.

20. The process of claim 1 wherein pressure drop through the feed side is 10 psi or less.

21. The process of claim 1 wherein the dissolved oxygen content of the feed water is increased upstream of the membrane module.

22. The process of claim 1 wherein permeation is performed intermittently.

23. A spiral wound RO, NF or UF module adapted for use in liquid filtration and having one or more leaves of membrane material wrapped around a mandrel and mounted in a shell, having the shell side of the membrane material as the feed side, having spacer material on the feed side between adjacent leaves or parts of a leaf, and the feed path having multiple passes through the spacer material and across the outer surfaces of the leaf or leaves of the module.

24. The module of claim 23 wherein the feed side flow path has an entrance to the outer surfaces of the leaf or leaves and an exit from the outer surfaces of the leaf or leaves and the width or cross-sectional area of the exit is 20% or less than that of the entrance.

25. The module of claim 24 wherein the width or cross-sectional area of the exit is 15% or less than that of the entrance.

26. The module of claim 23 wherein the passes are generally parallel to the mandrel.

27. The module of claim 26 wherein the first pass is more distant from the mandrel than the last pass.

28. The module of claim 23 having multiple leaves, at least one leaf having a different membrane material or chemistry than another leaf.

29. The module of claim 23 wherein the membranes have a hardness rejection of 50% or more.

30. The module of claim 23 module having 3 to 9 stages in the feed/concentrate side.

31. The module of claim 30 wherein each stage decreases in width or cross-sectional area along a flow path.

32. The module of claim 30 wherein each successive stage is reduced in cross-sectional area or width compared to a preceding stage.

33. The module of claim 23 wherein the module has a standard 40" length.

34. An apparatus comprising,

a) a membrane module contained in a shell with a feed/ concentrate side into where feed water enters and from where concentrate exits, and a permeate side from where treated water exits, wherein the feed/ concentrate side is configured to provide multiple flow passes;

b) a feed pump connected to the feed/concentrate side of the module;

c) a conduit or passage for concentrate to flow from the module to drain or another apparatus;

d) an inlet for feed to enter the feed pump; and,

e) an outlet for permeate to exit the module.

35. The apparatus of claim 34 further comprising,

a) a tank for storing a cleaning chemical,

b) conduits and valves to facilitate feeding the cleaning chemical to the module from time to time; and,

c) conduits and valves to facilitate discharging chemically contaminated permeate from the module.

36. The apparatus of claim 35 further comprising a venturi in a feed line to the module adapted to introduce cleaning chemical from the tank to feed flowing to the module.

37. The apparatus of claim 35 wherein the tank is located above the module and the conduits and valves are adapted to facilitate flowing cleaning chemical from the tank through the module by gravity flow.

38. A process comprising the steps of:

a) providing a spiral wound UF module having a feed/concentrate side and a permeate side;

b) flowing pressurized feed water through the feed/concentrate side of the module in a single pass, the feed water having a superficial velocity of between 0.05 and 0.4 feet per second over the last portion of membranes on the feed/concentrate side of the module; and,

c) collecting at least 70% of the feed water as permeate from the permeate side of the module.

39. The process of claim 38 wherein between 80% and 95% of the feed water is collected as permeate.

40. The process of claim 38 wherein the module has a permeability of about 0.6 gfd/psi or more.

41. The process of claim 39 wherein the module has a permeability of about 0.6 gfd/psi or more.

42. The process of claim 38 wherein the minimum feed side superficial velocity is in the range of 0.05 ft/s to 0.4 ft/s.

43. The process of claim 42 wherein either the minimum superficial feed side velocity or exit superficial velocity is in the range of 0.12 ft/s to 0.3 ft/s.

44. The process of claim 38 wherein the feed water is taken from a well and contacted with air to increase its dissolved oxygen content before flowing it to the module.

45. The process of claim 38 wherein the permeate is collected in a holding tank and the step of flowing pressurized feed water begins when the pressure or water level of the permeate in the holding tank reaches a selected limit.

46. The process of claim 45 wherein the step of flowing pressurized feed water is stopped when the level or pressure of permeate in the holding tank reaches a selected limit.

47. The process of claim 38 further comprising the steps of,

a) flowing water containing cleaning chemical to the feed/concentrate side of the module;

b) holding the cleaning chemical in the feed/concentrate side module for a reaction time;

c) discharging the cleaning chemical from the feed/concentrate and permeate sides of the module.

48. The process of claim 47 wherein the steps of claim 47 are started when the permeability of the membranes reaches a selected limit or at selected time intervals.

49. The process of claim 47 wherein the cleaning chemical is provided by mixing cleaning chemical into feed water flowing into the module.

50. The process of claim 47 wherein the cleaning chemical is provided in a flow of liquid into a concentrate outlet of the module.

51. The process of claim 47 wherein the cleaning chemical flows into the feed/concentrate side of the module by gravity induced flow.

52. The process of claim 38 wherein the permeate side of the module has no inlet from outside of the module.

53. The process of claim 38 wherein the holding tank has a pressure above ambient adapted to supply permeate to a user without further pressurization.

54. The process of claim 38 wherein the module has multiple stages on its feed side.

55. The process of claim 54 wherein the module has a membrane area exit and a first stage and the velocity of feed or concentrate over the membrane area exit is a factor of 1.2 or more times the velocity of feed or concentrate in the first stage.

56. The process of claim 38 wherein pressure drop through the feed side is 10 psi or less.

57. The process of claim 38 wherein the dissolved oxygen content of the feed water is increased upstream of the membrane module.

58. The process of claim 38 wherein permeation is performed intermittently.